

Historic Instruments to Foster Authentic Learning of Physics. The Historical Collection of Physics Instruments of the University of Palermo

Aurelio Agliolo Gallitto, Onofrio Rosario Battaglia & Claudio Fazio

Introduction

Empirical inquiry is the hallmark of the natural sciences, observing natural phenomena and reproducing them doing "experiments" to isolate and study the quantities characteristic of the phenomenon. Experimentation substantiates and contextualizes scientific knowledge and understanding. Laboratory is a perfect environment to foster student authentic learning [1-3], as it allows them to think about the phenomena they want to study, to discuss them in specific contexts, solving real problems related to data collection and to build models representing the relationships among the quantities experimentally studied. In this way students can develop skills and attitudes, not only knowledge, which is just an intermediary step in the process.

It may be interesting for the learner to deepen the relationships between the laboratory instruments as artifacts and the natural phenomena they were designed to study, also from an historical point of view [4].

University scientific museums and collections of historical instruments offer to the students the opportunity to understanding their use also in terms of their social, political, and scientific contexts. In particular, to redirect student common-sense ideas, about pressure and velocity in a fluid, towards conceptions more coherent with scientific knowledge [5], in this poster we discuss the Venturi effect and its applications: the Venturi meter, the Bunsen Burner and the hydraulic vacuum pump. Furthermore, we suggest very simple experiments, aimed at the demonstration of the Venturi effect, and illustrate two instruments of the Historical Collection of Physics Instruments of the University of Palermo, Italy [6].

The Historical Collection of Physics Instruments

The Historical Collection of Physics Instruments of the University of Palermo, on exhibit at the Department of Physics and Chemistry, in the historic building of via Archirafi 36, comprises more than 500 instruments and apparatuses. The oldest instruments date back to the early 19th century, when experimental Physics began to be taught in the University by using instruments and apparatuses, up to the middle of 20th century. The Collection mainly concerns mechanical, acoustic, calorimetric, optical and electromagnetic instruments made by manufacturers in France, Germany, England, as well as in Italy [4]. Although the oldest instruments were only employed for didactic demonstrations, the Collection faithfully reflects the main topics of the scientific research carried out in Palermo since the second half of the 19th century onward.

Contacts



The Venturi effect and its applications

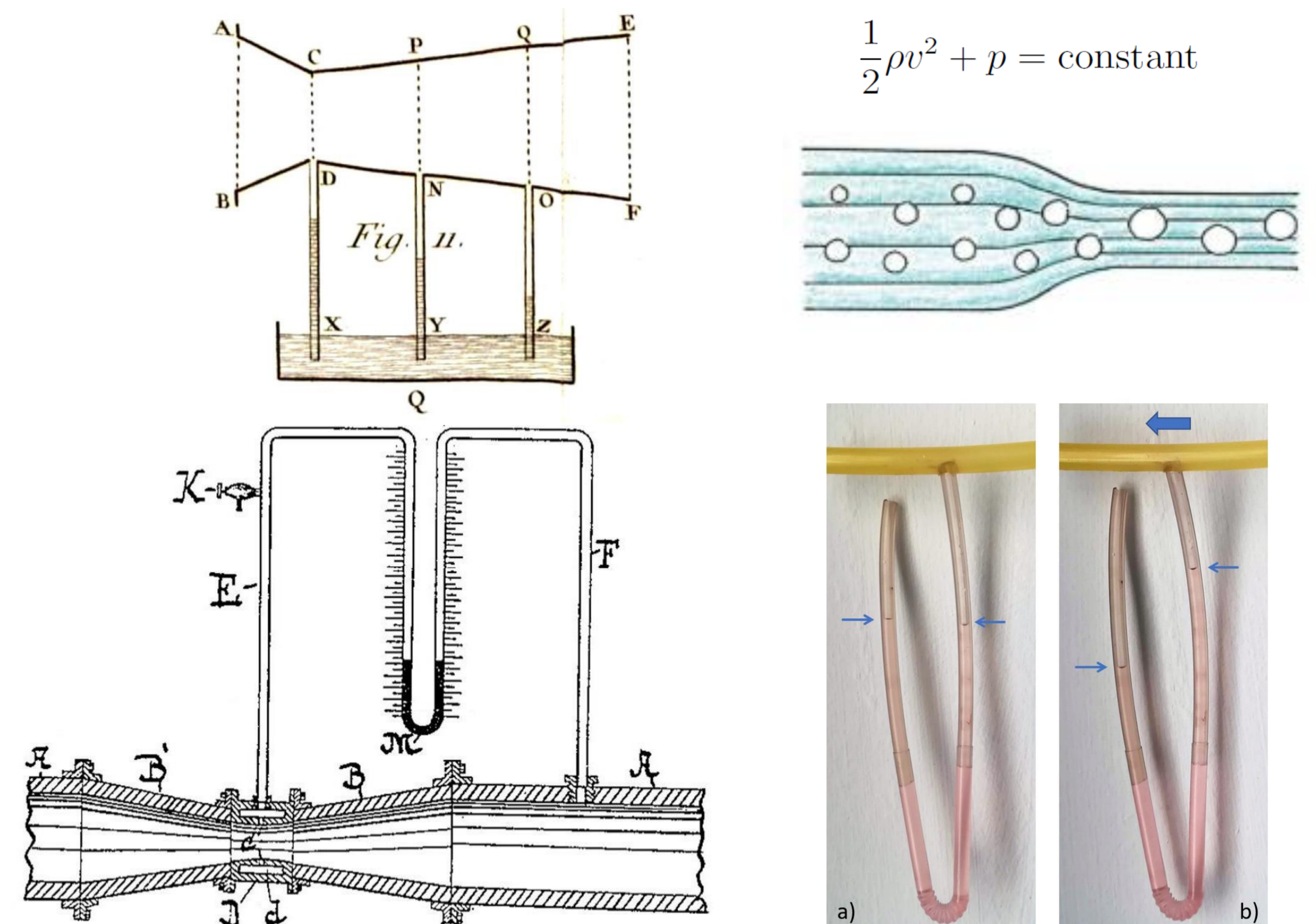


Illustration of the Venturi effect and the Venturi meter (right) with two suggested experiments (left) [6-8].

• The Bunsen burner and the Venturi vacuum pump



Illustration of two applications of the Venturi effect: the Bunsen burner (left) and the Venturi vacuum pump (right) [6, 10-11].

Discussion and conclusions

Historic instruments can be used to foster an authentic understanding of the laws describing the flow of a fluid, and to redirect some typical students' common-sense ideas about pressure and velocity in a fluid towards conceptions more coherent with scientific knowledge. Here, an approach to the understanding of the Venturi effect based on the study of historical instruments and by simple experiments is proposed.

Bibliography

- [1] Collins A, Brown J S, Newman S E 1989 *Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics* (Hillsdale, NJ: Lawrence Erlbaum Associates)
- [2] Newman F, Wehlage G 1993 *Educational Leadership* 8
- [3] Donovan S, Bransford J D, Pellegrino J W 1999 *How People Learn: Bridging Research and Practice* (Washington, DC: National Academy of Sciences)
- [4] Agliolo Gallitto A et al 2017 *Museologia Scientifica* 11 103
- [5] Suarez A, Kahan A, Zavala G, Marti A C 2017 *Phys. Rev. Phys. Educ. R.* 13 020132
- [6] Agliolo Gallitto A et al 2019 *Eur. J. Phys.* Submitted
- [7] Venturi G B 1797 *Recherches experimentales sur le principe de la communication laterale du mouvement dans les fluides, applique a l'explication de differens phenomenes* (Paris: Houel et Ducros, Theophile Barrois)
- [8] Hewitt P G 2019 *Phys. Teach.* 57 212
- [9] Herschel C 1888 *U.S. Letters Patent* no. 381373
- [10] Piccard J 1865 *Z. anal. Chem.* 4 45.
- [11] Hiscox G D 1909 *Compressed air* (New York: N. W. Henley)